CLAIMS

1. An angular velocity sensor comprising:

a tuning fork vibrator having two arms and a base to support the two arms together;

a drive unit formed on a main surface of each of the two arms in order to drive each of the two arms in an X-axis direction; and

a detection unit formed on a main surface of each of the two arms in order to detect vibration of each of the two arms in a Z-axis direction based on an angular velocity applied around a Y-axis, wherein

the detection unit is made up of a bottom electrode formed on the main surface of each of the two arms, a piezoelectric film formed on the bottom electrode, and a top electrode formed on the piezoelectric film;

the main surface having the detection unit thereon and a tilted side surface adjacent to the main surface cross each other at an acute angle; and

a center of at least the top electrode of the detection unit is shifted from a center of the main surface to a side opposite to the tilted side surface.

2. The angular velocity sensor of claim 1, wherein

the main surface of each of the two arms having the

detection unit thereon and the tilted side surface adjacent to the main surface cross each other at an acute angle; and

the center of at least the top electrode of the detection unit is shifted by a specific amount in accordance with a degree of tilt of the tilted side surface from the center of the main surface to the side opposite to the tilted side surface.

3. An angular velocity sensor comprising:

a tuning fork vibrator having two arms and a base to support the two arms together;

a drive unit formed on a main surface of each of the two arms driving each of the two arms in an X-axis direction; and

a detection unit formed on a main surface of each of the two arms in order to detect vibration of each of the two arms in a Z-axis direction based on an angular velocity applied around a Y-axis, wherein

the detection unit is made up of a bottom electrode formed on the main surface of each of the two arms, a piezoelectric film formed on the bottom electrode, and a top electrode formed on the piezoelectric film;

the main surface having the detection unit thereon and a tilted side surface adjacent to the main surface cross each other at an obtuse angle; and

a center of at least the top electrode of the detection unit is shifted from a center of the main surface to the tilted

side surface.

4. The angular velocity sensor of claim 3, wherein

the main surface of each of the two arms having the detection unit thereon and the tilted side surface adjacent to the main surface cross each other at an obtuse angle; and

the center of at least the top electrode of the detection unit is shifted by a specific amount in accordance with a degree of tilt of the tilted side surface from the center of the main surface to the tilted side surface.

5. The angular velocity sensor of claim 1 or 3, wherein

the drive units are made up of bottom electrodes formed on the main surface of each of the two arms across the center of the main surface, piezoelectric films formed on the bottom electrodes, and top electrodes formed on the piezoelectric films in such a manner as to be away from each other across the center of the main surface.

6. The angular velocity sensor of claim 1 or 3, wherein

the drive units are made up of bottom electrodes formed away from each other across the center of the main surface of each of the two arms, piezoelectric films respectively formed on the bottom electrodes, and top electrodes respectively formed on the piezoelectric films.

7. The angular velocity sensor of claim 1 or 3, wherein the tuning fork vibrator is formed by dry etching.

8. The angular velocity sensor of claim 1 or 3, wherein the tuning fork vibrator is made of a silicon-based material.

9. An angular velocity sensor comprising:

a tuning fork vibrator having two arms and a base to support the two arms together;

a drive unit formed on a main surface of each of the two arms in order to drive each of the two arms in an X-axis direction; and

a detection unit formed on a main surface of each of the two arms in order to detect vibration of each of the two arms in a Z-axis direction resulting from an angular velocity applied around a Y-axis, wherein

the drive unit is made up of a bottom electrode formed on the main surface, a piezoelectric film formed on the bottom electrode, and a top electrode formed on the piezoelectric film;

the main surface having the drive unit thereon and a tilted side surface adjacent to the main surface cross each other at an acute angle; and

an amount of Y-axis deformation of a part of the drive unit that is on a tilted side surface side of the center of the

main surface is smaller than an amount of Y-axis deformation of a part of the drive unit that is on a side opposite to the tilted side surface side of the center of the main surface when the two arms are driven in the X-axis direction.

10. The angular velocity sensor of claim 9, wherein

the drive units are made up of bottom electrodes formed on the main surface of each of the two arms across the center of the main surface, piezoelectric films formed on the bottom electrodes, and top electrodes formed on the piezoelectric films in such a manner as to be away from each other across the center of the main surface.

11. The angular velocity sensor of claim 9, wherein

the drive units are made up of bottom electrodes formed away from each other across the center of the main surface of each of the two arms, piezoelectric films respectively formed on the bottom electrodes, and top electrodes respectively formed on the piezoelectric films.

12. The angular velocity sensor of claim 10 or 11, wherein

the main surface of each of the two arms having the drive units thereon and a tilted side surface adjacent to the main surface cross each other at an acute angle;

the top electrode that is formed on the tilted side surface

side of the center of the main surface is smaller in width in the X-axis direction than the top electrode that is formed on a side opposite to the tilted side surface side of the center of the main surface; and

both the top electrodes have an equal center position and an equal length in a Y-axis direction.

13. An angular velocity sensor comprising:

a tuning fork vibrator having two arms and a base to support the two arms together;

a drive unit formed on a main surface of each of the two arms in order to drive each of the two arms in an X-axis direction; and

a detection unit formed on a main surface of each of the two arms in order to detect vibration of each of the two arms in a Z-axis direction resulting from an angular velocity applied around a Y-axis, wherein

the drive unit is made up of a bottom electrode formed on the main surface, a piezoelectric film formed on the bottom electrode, and a top electrode formed on the piezoelectric film; and

in a case where the main surface having the drive unit thereon and a tilted side surface adjacent to the main surface cross each other at an obtuse angle, an amount of Y-axis deformation of a part of the drive unit that is on a tilted side

surface side of the center of the main surface is made larger than an amount of Y-axis deformation of an other part of the drive unit that is on a side opposite to the tilted side surface side of the center of the main surface when the two arms are driven in the X-axis direction.

14. The angular velocity sensor of claim 13, wherein

the drive units are made up of bottom electrodes formed on the main surface of each of the two arms across the center of the main surface, piezoelectric films formed on the bottom electrodes, and top electrodes formed on the piezoelectric films in such a manner as to be away from each other across the center of the main surface.

15. The angular velocity sensor of claim 13, wherein

the drive units are made up of bottom electrodes formed away from each other across the center of the main surface of each of the two arms, piezoelectric films respectively formed on the bottom electrodes, and top electrodes respectively formed on the piezoelectric films.

16. The angular velocity sensor of claim 14 or 15, wherein

when the main surface of each of the two arms having the drive units thereon and a tilted side surface adjacent to the the main surface cross each other at an obtuse angle, the top

electrode that is formed on the tilted side surface side of the center of the main surface is larger in width in the X-axis direction than the top electrode that is formed on a side opposite to the tilted side surface side of the center of the main surface, and both the top electrodes have an equal center position and an equal length in a Y-axis direction.

17. The angular velocity sensor of claim 9 or 13, wherein the tuning fork vibrator is formed by dry etching.

18. The angular velocity sensor of claim 9 or 13, wherein the tuning fork vibrator is made of a silicon-based material.

19. The angular velocity sensor of claim 9 or 13, wherein the detection unit formed on the main surface of each of the two arms is made up of a bottom electrode formed on the main surface of, a piezoelectric film formed on the bottom electrode, and a top electrode formed on the piezoelectric film.

20. A method for manufacturing an angular velocity sensor comprising: a tuning fork vibrator having two arms and a base to support the two arms together; a drive unit formed on one main surface of each of the two arms in order to drive each of the two arms in an X-axis direction; and a detection unit formed on the main surface of each of the two arms in order to detect

vibration of each of the two arms in a Z-axis direction resulting from an angular velocity applied around a Y-axis, the method comprising:

forming a bottom electrode on an XY surface of a substrate;

forming a piezoelectric film on the bottom electrode;

forming a top electrode on the piezoelectric film;

forming the drive unit and the detection unit from the bottom electrode, the piezoelectric film and the top electrode; and

forming the tuning fork vibrator by dry etching the substrate in such a manner that a Y-axis direction of the two arms coincides with a Y-axis direction of the substrate, wherein

as an incident angle of plasma used for the dry etching on a YZ surface of the substrate gets larger,

a center of at least the top electrode of the detection unit formed on the main surface is made to be shifted by a specified amount from a center of the main surface towards an X-axis edge of the substrate.